The dust in Sauron's eye:

Observational and experimental results on the debris disk around HR 4796

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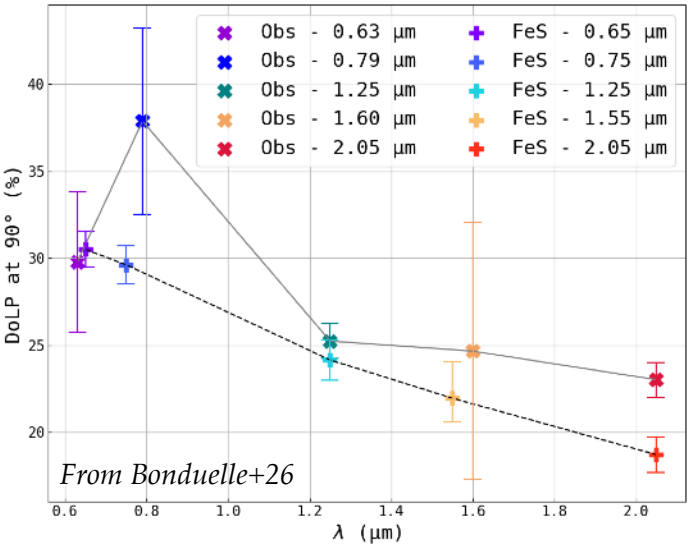
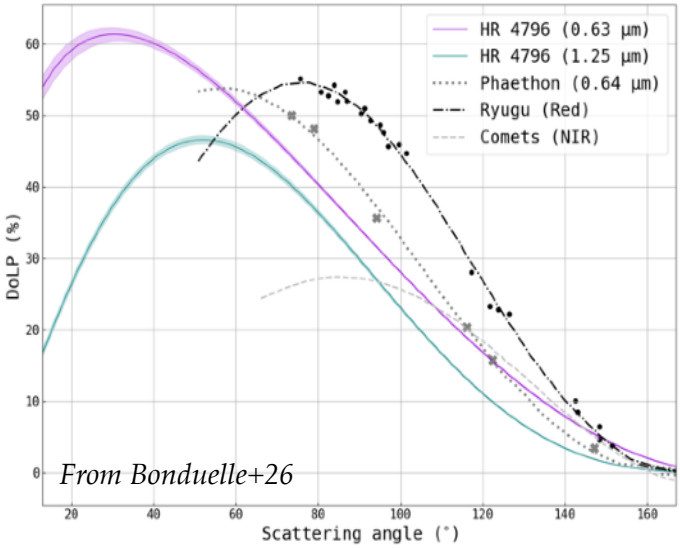
Planetary systems are formed within circumstellar disks, initially called protoplanetary and consisting of gas, ice and dust particles. With the depletion of all (or most of) the gas and dust, these protoplanetary disks evolve into debris disks, reservoirs of planetesimals, km-sized rocky and icy bodies, whose mutual collisions grind the material into small μm- or mm-sized particles. Debris disks are therefore thought to be the markers of a successful formation of planetesimals, and the dust they contain is an indicator of the composition of exoplanetary materials.
The optical properties of the dust particles orbiting in a disk (scattering phase function -SPF; degree of linear polarisation -DoLP, reflectance) can be retrieved through scattered light imaging, and are linked to the physico-chemical properties of the dust particles (size, shape, composition...).

The debris disk surrounding the A type star HR4796 is a bright, narrow disk, that has been observed at multiple wavelengths in scattered light and presents several peculiarities, especially an unusually high DoLP at small scattering angles. In this work, we aim at understanding the properties of the dust particles in HR4796, by combining multi-wavelengths scattered light observations, laboratory experiments, and results from Solar System objects. We use scattered light observations of HR 4796, obtained with SPHERE/IRDIS and SPHERE/Zimpol. We forward-model those observations using a novel joint parametric approach to constrain the morphology, the SPF, and the DoLP of the disk. We then analyse these results in regard with the DoLP we measured in laboratory on a dust analogue, previous findings on HR 4796 and on some Solar System asteroids and comets. We find that the material providing the best match to these properties in the near infrared appears to be 50-100 µm large iron sulphides particles, such as pyrrhotite and troilite. Such iron sulphides are among the opaque minerals that are probable contributors to the low albedo of some Solar System small bodies (B/C/D/P-type asteroids, comets etc.).

DoLP at a 90° scattering angle for multiple λ for:
✖ : *observations of HR 4796*
✚ : *laboratory measurements on iron sulphides*



DoLP as a function of the scattering angle for:
- *observations of HR 4796 (purple and teal)*
- *Solar System objects*



The DoLP angular dependence of HR 4796 is notably different from that of Solar system comets and seems closer to that of some asteroids. Combined with the spectral reflectance in the near infrared, these result suggest 50-100 µm scatterer sizes, possibly indicating some space weathering processes on the dust particles in HR 4796.

This work is carried out in the context of the ÉPOPÉE collaboration (financed by the PNP).

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